

Dissolution morphology of iron (oxy)(hydr)oxides exposed to *Shewanella oneidensis*

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Much of the work on respiration of ferric iron minerals by dissimilatory metal reducing organisms has focused on understanding the rate limiting processes. Here, we use iron (oxy)(hydr)oxide particulate coated glass slides to examine the relationship between dissolution morphology and the spatial distribution of *Shewanella oneidensis* MR-1 during anaerobic respiration. It was found that the dissolution morphology of the particulate-coated slides in the presence of wild-type organisms was heterogeneous and dissolution features were commensurate with microcolony size and distribution (Fig. 1). This contrasts to slides exposed to the abiological chemical reductant, 9,10-anthrahydroquinone-2,6-disulfonate (AH₂DS, reduced form of AQDS), which dissolves the coatings homogeneously. A homogenous dissolution morphology also resulted when slides were exposed to AQDS and the solid iron mineral respiration deficient mutant, *ΔgspD*. The results suggest that the respiration of the wild-type organisms is limited in part by transport of the cells on the mineral surface whereas respiration by soluble electron shuttles like AQDS is primarily limited by surface processes due to their more rapid rate of diffusion. This in turn is expected to increase the bioavailability of the iron (oxy)(hydr)oxides.

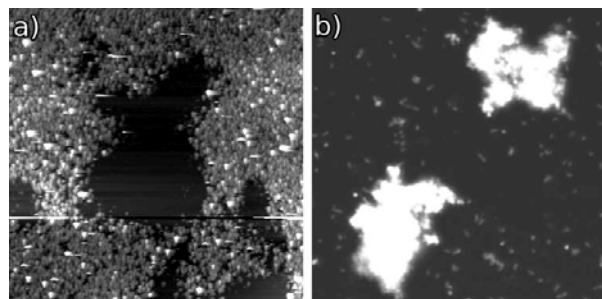


Figure 1: a) 85 μm atomic force microscope image showing dissolution morphology of iron (oxy)(hydr) oxides exposed to wild-type *Shewanella oneidensis* MR-1. b) 103 μm confocal microscope image showing microcolonies.

Thermal conductivity of MgO and MgSiO₃ perovskite at lower mantle conditions

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Thermal conductivity sets the balance between advective and conductive heat transport, and thus influences the large scale structure and dynamics of the mantle. The value of the thermal conductivity of the lower mantle controls the thermal evolution of the core and influences the generation of the magnetic field. Despite its importance, the thermal conductivity of insulators at lower mantle conditions remains unknown. We have predicted the lattice (phonon) thermal conductivity of the major materials of the lower mantle: MgO periclase and perovskite-structured MgSiO₃ over the relevant pressure-temperature range. Our first principles calculations are based ab initio molecular dynamics in which the forces are computed from density functional theory. To compute the thermal conductivity, we use a reverse perturbation steady-state non-equilibrium method in which a finite spatial temperature gradient is maintained by a heat flux via controlled elastic pseudo-collisions. Results for MgO at ambient pressure and 1000 K and 2000 K agree with experimental results to within 15 %. Predicted values at 136 GPa and 4000 K are substantially higher than some previous estimates of the lattice contribution and much larger (> 10 times) than recent experimental measurements of the radiative contribution.